GUIDELINES FOR

ENVIRONMENTAL PROTECTION MEASURES

AT

CHEMICAL STORAGE FACILITIES

Waste Management Branch

October, 1978

TABLE OF CONTENTS

INTRODUCTION

The purpose of these guidelines is to provide assistance to Ministry of the Environment staff in the assessment of environmental protection measures at existing chemical product storage facilities and in the development and approval of such measures at new installations.

LEGISLATIVE AUTHORITY

Both The Environmental Protection Act (Section 5(1), Section 14(1)) and The Ontario Water Resources Act (Section 32(1)) prohibit the discharge of materials which may impair the environment or pose a public health hazard.

In addition, both Acts require the mandatory reporting of discharges of this type (ie., Section 32(3) of The Ontario Water Resources Act and Section 13(1) of The Environmental Protection Act).

It is the intent of these guidelines to give direction to the implementation of preventative measures to reduce the potential for violations of these general provisions.

While there is no statutory authority to require that such measures be implemented, these guidelines are an indication of Ministry policy goals and objectives respecting pollution prevention and public health protection in the vicinity of chemical storage facilities.

GENERAL PRINCIPLES OF ENVIRONMENTAL PROTECTION MEASURES

Because of the wide diversity of chemical products, specific environmental protection measures should be based on sound engineering principles taking into account the nature and properties of the material under consideration.

The following general principles shall be applied to the assessment of environmental and public health protection measures at chemical products storage facilities:

1. Facilities should be provided around chemical products storage facilities to prevent the uncontrolled release of products into the environment consistent with public health and safety.

2. Human health and safety shall take precedence over environmental protection in cases of emergency.

3. Procedures which are consistent with the recommendations of the Manufacturing Chemists Association with respect to engineering control of hazards, as outlined in Chemical Safety Data Sheets published by MCA for specific chemicals, should be followed.

4. In the absence of recognized procedures for the particular chemical product under consideration, environmental protection measures should be negotiated

between Ministry of the Environment representatives and the company taking into account the nature and properties of the product.

5. Environmental protection measures should be required of all new storage facilities and the replacement or reconstruction of existing installations and approved by the Ministry of the Environment in accordance with regular approvals procedures.

DEFINITIONS

For the purposes of these guidelines, chemical products are defined as those chemicals or materials which are derived from chemical reactions, are intended as raw materials for chemical reactions or are blended or used as solvents or carriers.

Excluded from this definition are:

1. Radioactive or nuclear materials subject to regulations of the Atomic Energy Control Board;
2. Petroleum products subject to the requirements of The Gasoline Handling Act and the Gasoline Handling Code;
3. Stockpiles of solid materials such as aggregates, sands and gravels, coal, mine tailings, waste rock and concentrates from mining operations.

APPLICATION

It is the intent of these guidelines that they be applied most rigorously to new chemical storage installations or the replacement or reconstruction of existing installations.

Such application should, however, be consistent with good practicable engineering principles and space availability.

In addition, these guidelines may be used as a basis for the development of abatement measures at chemical storage facilities where environmental contamination has occurred.

GENERAL PRINCIPLES OF ENGINEERING CONTROLS

As a first line of defence, all storage facilities should be designed, fabricated and installed in such a manner that risk of loss is minimized.

Materials of construction of storage facilities should be consistent with the safe long term storage of the chemicals products under consideration.

Changes in the chemicals to be stored in a given facility should not be permitted until a competent assessment has been made of the suitability of the facility for such a change in service.

The degree to which measures are taken to ensure the integrity of a storage facility should be dictated by the severity of the potential environmental, health and safety effects of the loss of the product to be stored.

Where possible, storage facilities should not be located where, in the event of a spill, waste product may enter a natural watercourse or a sewerage or drainage system, or contaminate potable surface or groundwater supplies, or contribute to air contamination and malodours.

GUIDELINES FOR THE STORAGE OF LIQUIDS

General

The purpose of this guideline is to ensure the containment of all spills and accidental losses of chemicals from storage systems consistent with the following objectives:

(i) Personnel protection

(ii) Fire protection

(iii) Environmental protection (air, surface and groundwaters)

The schematic diagrams appended to these guidelines represent idealized application of the recommended facilities and procedures.

I. Containment Systems for Storage Tanks

1. In order to meet the general objectives previously stated, the installation of dyked containment systems around all liquid chemical storage tanks is the recommended technology.

2. Tanks with storage capacity of 10,000 barrels or greater which are used to store flammable materials should be dyked separately for fire protection purposes.

II. Compatibility of Liquids

In considering the storage of more than one product within a common dyked enclosure, whether by initial design or subsequent change in tank (product) service, compatibility must be established to ensure that the potential for violent reactions between two or more chemicals during an emergency is minimized.

This should be the subject of evaluation between Ministry staff and the company involved.

Unstable products should not be stored within common dyke systems.

III. Tank Location

1. Tank location will normally be based on process needs and accessability to production equipment so as to provide good materials flow. However, considerations, such as the hazards associated with the flammability, and toxicity of the chemical may dictate a location more remote from production areas. This should not, as a consequence, locate the storage tank close to populated urban areas or close to environmentally sensitive areas.

2. Tank containment systems must not be located over any existing piping or drainage system, active or inactive. Any such piping must be removed prior to the installation of the storage facility.

3. The main criteria governing the location of the various components of any chemical storage system should be, in order of priority: the safety of the operating personnel, public health and safety and environmental protection.

IV. Volume of Tank Containment Systems

1. Tank containment shall be comprised of dykes around chemical storage tanks to prevent loss of chemical in the event of an emergency.

2. The contained volume of the impoundment within a dyke system enclosing one or more tanks is given as the total enclosed volume, minus the volume up to the height of the dyke of:

a) All tanks other than the largest, and,

b) All tank foundations.

The volume of piping, pumps, pump bases, pipe supports and other minor obstructions may be ignored if their total volume is less than two percent of the volume of the impoundment.

3. Dykes containing stored materials which are flammable or require foam or deluge system protection must be sized so as to provide a minimum impoundment volume equal to the larger of:

a) 150% of the volume of the largest tank, or

b) 100% of the volume of the largest tank plus 25% of the volume of all of the remaining tanks.

4. For all other materials, the volume of the dyke impoundment must be at least 110 percent of the volume of the largest tank within the impoundment.

5. In choosing the location of a tank within a dyke system, the horizontal trajectory of a potential leak must be taken into consideration to ensure that all leaks will be confined within the impoundment. As a guide, the perpendicular distance from the tank face to the top of the inside face of any dyke should be a minimum of half the height of the tank above the top of the dyke wall (see Figure II). In cases involving very high risk of loss or damage, calculations should be made to determine the required distance.

6. A collection sump within the dyked area should be provided with a minimum capacity of 50 cubic feet.

V. Drainage Collection and Disposal from Tank Containment Systems

1. Facilities must be provided to collect, treat and dispose of drainage and leakage from the tank storage dyke system.

2. Overflow weirs and piping are essential in containment systems around storage tanks containing chemicals not miscible with water and heavier than water and must be capable of handling normal surface runoff and the maximum waterspray cooling and fire protection system flow (see Figures I and IV).

3. Ideally, all plants should have holding lagoons for the collection of dyke system drainage and surface runoff from process areas. However, it is recognized that good engineering practice and management can achieve the objective that no spilled material escapes to the environment without the use of a lagoon. Therefore, there is scope to exercise good technical and engineering judgement in the application of this requirement.

4. The volume of holding lagoons should be 100 percent of the volume of the largest dyke containment system draining into the lagoon plus 1600 cubic feet (10,000 imperial gallons) per acre of process area draining storm runoff into the lagoon.

5. The lagoon must be maintained as empty as possible during normal operation (see Section VI(5)).

6. Subsequent to an emergency, and during normal operations, collected drainage and the contents of the holding lagoons should be directed to appropriate treatment, consistent with the nature of the discharge and treatment necessary for environmental protection. These matters should be reviewed by Ministry staff with the plant personnel prior to installation.

7. Pipes draining process areas must have capacity to handle the larger of:

a) Runoff from the twenty-year design storm flow at the plant location, or

b) Maximum potential water spray cooling and fire protection flow in the area to be drained.

8. Pipes draining dyke systems must be capable of handling the maximum potential water spray cooling and fire protection system flow within the dyke containment.

9. An emergency by-pass sewer for a holding lagoon (see Figure V) should be available to handle volumes in excess of the storage capacity of the lagoon and must be able to accommodate the larger of:

a) The largest waterspray cooling and fire protection system flow from any dyke containment system connected to the lagoon;

b) Runoff from the twenty-year design storm flow for all process areas which drain into the lagoon system.

10. The emergency by-pass sewer must be closed during normal operations and only opened when the holding capacity of the lagoon is filled.

11. Where a lagoon system is physically impossible due to space limitations, or in the case of single storage tanks in areas remote from all other dyked or process

areas, a sump should be installed downstream of the dyke valve. The sump must have an emergency overflow to a diversion sewer capable of accepting the largest waterspray cooling and fire protection system flow from the dyked area. The sump must be able to hold runoff from a one-inch rainfall over the total area of the dyke containment before any liquid reaches the level of the diversion sewer (see Figure III). During normal operations, effluent from the sump should be directed to appropriate treatment facilities determined in the same manner as for holding lagoon discharges. Single storage tanks containments for non-flammable, non-hazardous and biodegradable materials do not require this external sump.

VI. Design Criteria for Containment Systems

Dykes

1. Dykes should be sized in accordance with Section IV of this guideline.
2. All dykes should be equipped with a sump from which runoff or spilled material may be pumped, or drained by means of a dyke valve.
3. The floor of a dyke should have a minimum slope of 1% toward the sump to ensure that

any runoff or spilled material will drain to the sump.

4. There should be no sewer connections from any dyked area, other than through the dyke valve.

5. The floor and walls of any dyked area should be constructed of impermeable materials which are compatible with the contents of all tanks within the dyked area.

6. Overhead piping should be used for the purpose of filling tanks from the process or from raw material sources such as tank car or tank truck unloading stations.

7. There should be no piping through the basin floor. It is recommended that piping through the dyke wall be avoided. If piping through dyke walls is unavoidable, it should be sealed so that spilled material cannot escape from the dyke around the piping.

8. Overflow lines from tanks should be extended to near the floor of the dyked area.

9. In tank farms containing flammable materials emergency block valves should be located at the tank outlet nozzle to prevent draining of tanks into the dyke in the case of a fire.

10. Multiple tanks containing the same materials should be piped in such a way so as to prevent failure of one tank (or piping) from causing the remainder of the tanks to lose their contents. If this is not possible, the tanks should be regarded as one tank and the dyke sized accordingly.
11. Materials which are incompatible from a reactive chemical standpoint, should not be stored in tanks within the same dyked area.
12. Tanks containing materials which would cause damage if exposed to other tanks, tank supports, or piping should be located in separate dyked areas.
13. Special provisions should be made for materials which react with water.
14. All dykes should be considered as permanent installations and should be structurally sound. Soil conditions must be reviewed regarding settling and drainage. If necessary, guard posts or other protection should be provided to protect the dyke from possible structural damage due to heavy vehicles.
15. Tanks containing toxic and/or non-biodegradable materials which must be buried should be buried above ground and conform to this engineering guideline.

16. Dykes containing liquids heavier than, and immiscible with water (ie., with specific gravity greater than 1.0) should be equipped with an overflow weir as well as a sump, if required under Section IV(2). (See Figures I, and IV).

Dyke Valves and Piping

1. The distance from a dyke valve to the top of the inside face of the dyke wall should not be less than 25 feet for flammable or toxic material storage. Where non-toxic, non-flammable biodegradable materials are stored, the dyke valve must be outside the toe of the dyke.

2. Dyke valves should be locking position indicator valves. They should normally be locked in the closed position, with the fire protection and plant supervision retaining keys.

3. The construction materials for dyke valves and piping must be compatible with the materials being stored within the dyke.

4. All piping and dyke valves must be protected from freezing by burial below frost level. If this is impossible, the line must be traced and insulated.

5. Drainage from dykes containing materials which are heavier than water requires two separate pipes and valves. The pipe from the sump is for the disposal of intermittent storm runoff and the disposal of tank spillage. The pipe from the overflow weir carries the overflow waterspray and the fire protection system water which exceeds the volume of the basin (see Figure I).

Lagoons

1. The minimum distance from the inside face of the dyke wall to the inside face of the lagoon should be 75 feet for flammable materials. The minimum distance for other materials is 10 feet outside the toe of the dyke.
2. The materials of construction for the lagoon sides and floor must be compatible with all materials which may be discharged into the lagoon and must also be impermeable to all of these materials.
3. The maximum lagoon wall elevation used in calculating the volume of the lagoon should be lower than the elevation of the top of the lowest curb, dyke, etc., surrounding areas draining into the lagoon.

Instrumentation and Alarms

1. Proper instrumentation should be provided on all storage tanks and piping to and from the tanks in order to keep operating personnel adequately informed as to the existing conditions. Alarms should be provided to give adequate warning of conditions which, if not corrected, may result in a spill. For toxic and/or non-biodegradable materials a back-up method of detecting high levels shall be provided.
2. All remote or instrument-operated valves should be set so as to fail in the safest position.

Pumps

1. Pumps handling flammable materials and water-cooled pumps with a continuous flow of water through them should be placed on a separate pad outside the dyke and shall be drained to the lagoon through a separate pipe and valve, at least to the downstream end of the normal dyke valve.
2. Pumps in other services may be placed inside or outside the dyked area. The elevation of pumps within a dyke should be such that they are not rendered inoperative due to an accumulation of rainwater or material from minor leaks.
3. All pumps and electrical wiring must conform to the applicable hazardous area classification.

VII. Operation of Containment Systems

1. All materials, including storm runoff, which enter the lagoon should be analyzed and should not be discharged from the lagoon to the sewer system unless a pre-set quality standard is met or exceeded. This standard for effluent quality shall be determined by the operating plant and the Ministry of the Environment before the system is put in service. Materials not meeting this standard must be treated or re-used in the process.

2. Dyke valves normally should be in the closed position. A valve may be opened for short periods to drain storm water from a dyke but it must be attended at all times during the drainage periods, and shut and locked immediately thereafter. Aside from routine operating checks, the only other time that a dyke valve should be open is when deemed essential in an emergency situation.

3. For dykes utilizing sumps downstream of the dyke valve rather than lagoons, special arrangements will be necessary. As the sump is normally to be kept dry, flow from the dyke to the sump must then be pumped out. This material must be tested as stated in Part (1) of this section and, depending on the results, be pumped to the sewer or into a pumper truck to be recycled or treated.

4. In normal operation, lagoons should be maintained at less than 25% full, preferably at about 10% of capacity if possible.

5. Proper planning must be made in order to provide for recycle of all materials collected as a result of a leak or spill. In the event spilled materials cannot be recycled to the process, proper disposition of such material shall be provided for. Special provisions will have to be made for the recovery and disposition of materials which solidify when exposed to ambient temperature.

VIII. Preventive Maintenance

1. The maintenance of containment systems is the responsibility of the owner, however, provisions must be included in the design so that

adequate inspection and testing may be accomplished.

2. All dykes should be inspected at regular intervals in order to assure their structural soundness.

3. All storage tanks should be inspected and thickness tested at regular intervals.

4. All controls and alarms should be tested at regular intervals in order to ensure that they will operate properly when required.

5. All conservation vents, safety valves, flame arrestors, spare pumps, etc., should be checked or tested on a regular basis.

6. All dyke valves and drain lines should be checked for proper operation and flow and sumps be cleaned at regular intervals.

7. Provisions for the detection of tank settlement should be incorporated at the perimeter of the dyked area, and for large tanks within the dyked area.

8. For the storage of corrosive materials, leak detection "telltales" such as grooves in the concrete slab foundation or pairs of bare conductor wires which can be checked periodically for electrical resistance are recommended.

GUIDELINES FOR THE STORAGE OF GASES AND VOLATILE LIQUIDS

General

The purpose of this guideline is to minimize the potential adverse effects of all spills and accidental losses of gaseous or volatile chemicals from storage systems for the purposes of:

(i) personnel protection

(ii) fire protection

(iii) environmental protection (atmospheric and surface and groundwater)

The primary approach to this objective will be the application of loss control technology and optimum dispersion into the atmosphere of uncontrollable losses.

Many volatile pressurized materials such as ammonia have been the subject of extensive development of safety systems and response to major disasters. Reference should be made to available sources of information such as Chemical Safety Data Sheets published by the Manufacturing Chemists Association, Hazardous Materials Emergency Action Guide published by U.S. Department of Transportation, or other relevant sources of information for appropriate safety systems.

Containment Systems for Storage Tanks

1. In order to meet the general objectives, the installation of dyked containment systems around all volatile liquid chemical storage tanks containing products with true vapour pressures less than 11.0 psia is the recommended technology.

2. Pressurized storage tanks containing gaseous or volatile chemicals with true vapour pressures greater than 11.0 psia do not normally require dyked containment systems. The ground around the tank, however, should be sloped away from the underside of the tank.

3. Gaseous or volatile chemical storage tanks as defined in Item 2 above which have water deluge systems for purposes of personnel or fire protection, and which products are readily miscible with water, should have containment or drainage systems capable of collecting the largest deluge system waste volume. If possible, the containment area should be located away from the tank and the ground sloped from the tank toward this area with a minimum slope of one percent.

Design, Operation and Maintenance of Drainage Collection and Disposal From Tank Containment Systems

Facilities and procedures previously described for liquid storage tanks must be applied to containment systems for volatile liquid and gaseous product storage.

Control of Vapour Emissions from Storage Tanks

1. Chemicals with a true vapour pressure greater than 11.1 psia should be stored in closed system pressure-resistant tanks.
2. Chemicals which are not miscible with water and which have true vapour pressures in the range 3.0 to 11.1 psia should be stored in floating roof tanks or tanks equipped with conservation vents.
3. Chemicals which are not miscible with water and which have true vapour pressures less than 3.0 psia may be stored in vented fixed roof tanks, except in instances where the chemical generates vapours in concentrations that pose an occupational or public health hazard or exceed regulations under The Environmental Protection Act.
4. The minimum tank size for the application of floating roof tank requirements of item 2 should be 5,000 barrels (35,000 gallons).

5. Tank vents in fixed roof tanks should be located to maximize dispersion of product vapours.

6. Emergency vents for closed system pressurized tanks should be located to maximize dispersion of gases in the event of an emergency. In extreme cases, this may require the use of vent stacks or pipes to disperse gases at a height which does not impinge on personnel or private property. Alternatively, flammable vapours from vents and reliefs may be directed to flare stacks for combustion.

DRUM STORAGE

Drum storage in itself does not constitute a major environmental hazard. However, to be consistent with the principles applied to tank storage of chemicals, certain approaches should be adopted to minimize or prevent losses and to preclude major environmental problems.

Drums should be clearly identified as to their contents, well sealed and constructed of materials which are resistant to corrosive attack from the contents.

Groups of drums should be arranged such that the contents are compatible and do not increase the potential for violent chemical reactions or explosive hazards.

Storage of drums of flammable liquids should be as follows:

1. Inside Warehouses

   Main aisles not less than eight feet wide and separation between groups of drums not less than four feet.

   Stack height and group quantities of drums should not exceed the following:

   Class 1A liquids: flash point below $73^{\circ}F$ and boiling point less than $100^{\circ}F$ = 50 drums two high

Class 1B liquids: flash point below 73°F and boiling point at or above 100°F
= 100 drums two high

Class 1C liquids: flash point above 72°F and below 100°F
= 300 drums two high

2. Outside Storage

A maximum of 1200 drums may be stored adjacent to a building used for handling or storing flammable liquids if it has a two-hour fire wall with no openings within 10 feet of such storage.

The storage area should be kept free of weeds and combustible materials and be sloped and curbed on three sides to direct spills and drainage to an appropriate treatment or disposal system.

Stack height and group quantities of drums should not exceed the following:

Class 1A liquids: 80 drums two high

Class 1B liquids: 160 drums two high

Class 1C liquids: 480 drums two high

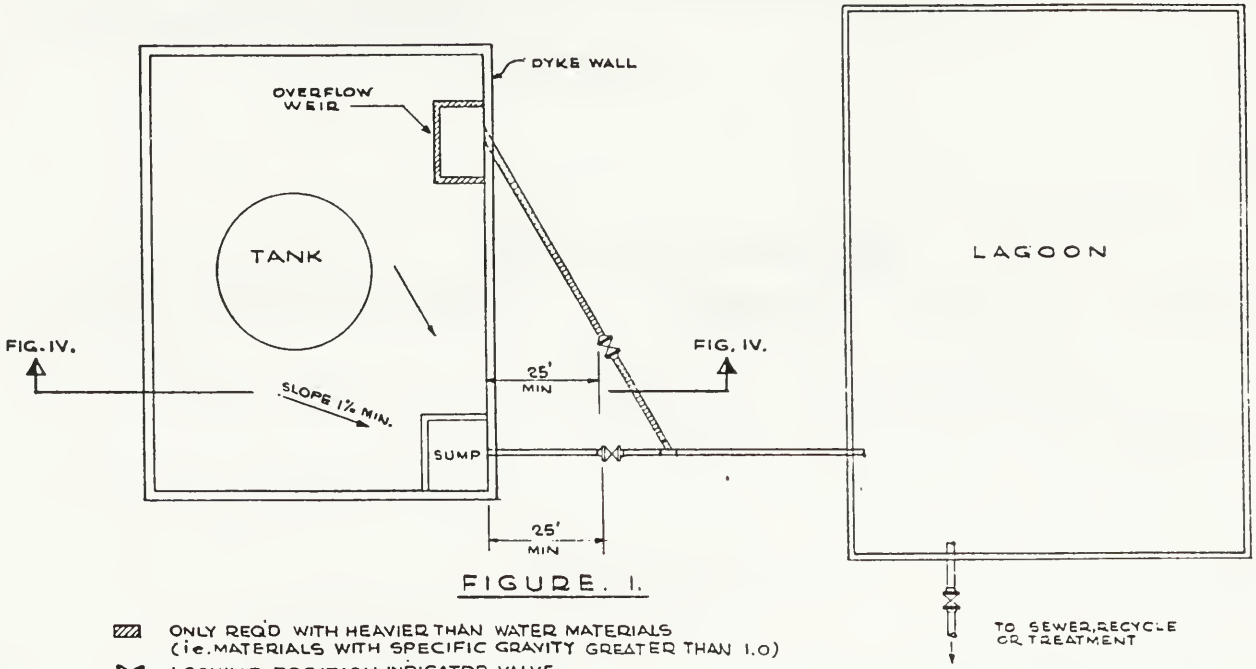

FIGURE. 1.

▨ ONLY REQ'D WITH HEAVIER THAN WATER MATERIALS (ie. MATERIALS WITH SPECIFIC GRAVITY GREATER THAN 1.0)

⋈ LOCKING POSITION INDICATOR VALVE

PLAN VIEW
OF NORMAL INSTALLATION

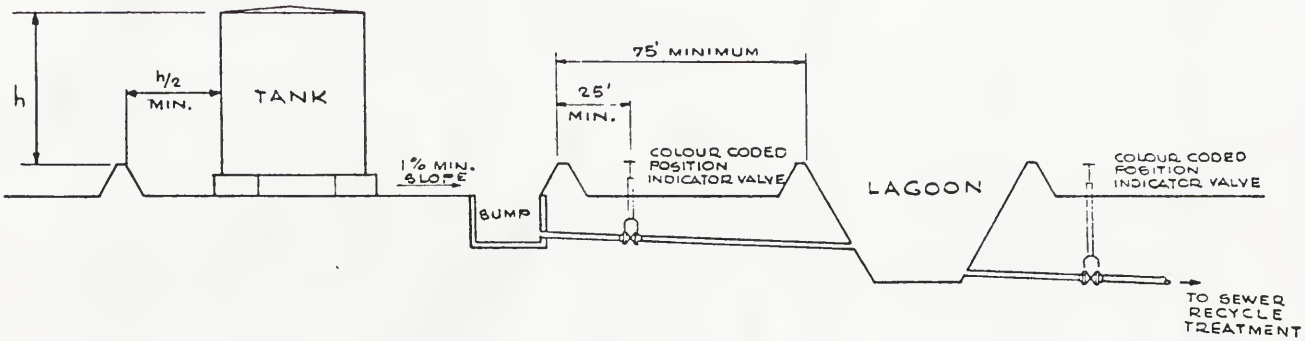

FIGURE. II.

NOTE.

UNDERGROUND PIPING MUST BE PROTECTED AGAINST FREEZING SEE SECTION 4.2.4.

CROSS SECTION
OF LAGOON SYSTEM

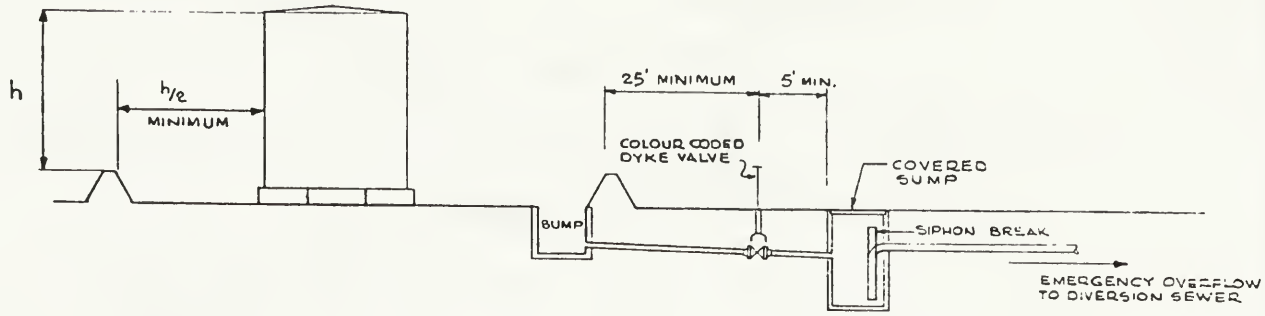

FIGURE III.

NOTE

UNDERGROUND PIPING MUST BE PROTECTED AGAINST FREEZING SEE SECTION 4.24.

CROSS SECTION
OF NON LAGOON SYSTEM

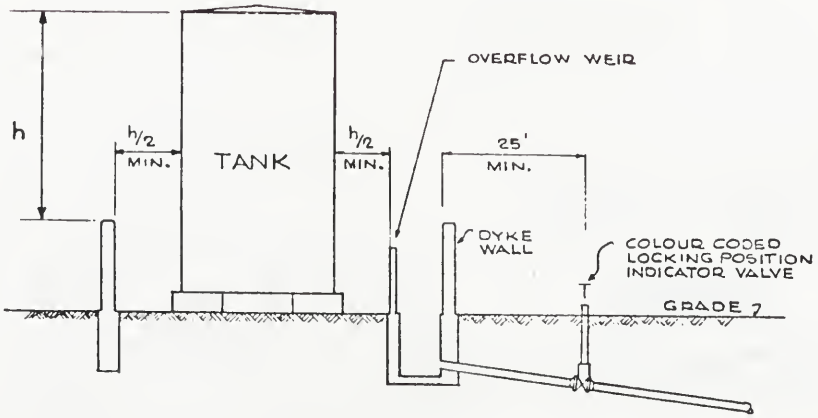

FIGURE. IV.

NOTE

UNDERGROUND PIPING MUST BE PROTECTED AGAINST FREEZING SEE SECTION 4.2.4.

CROSS SECTION
SHOWING OVERFLOW WEIR

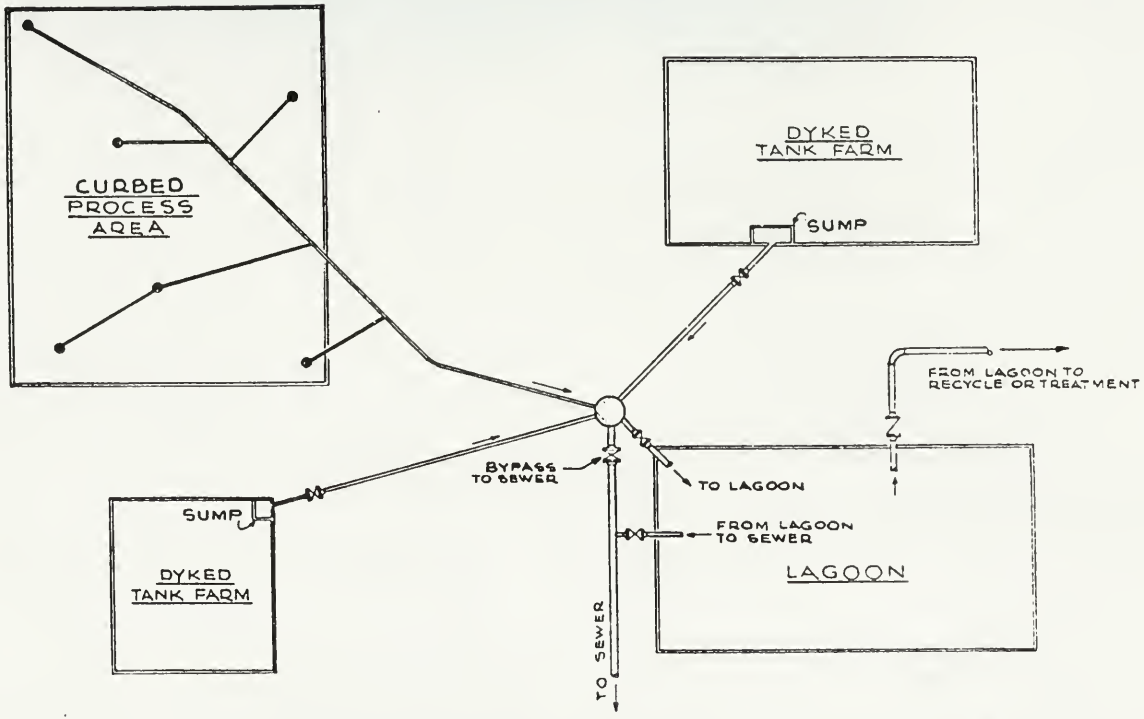

FIGURE. V.

LOCKING POSITION INDICATOR VALVE

CATCHBASIN

SCHEMATIC OF A TYPICAL
LAGOON SYSTEM